ULTRAMIZER® PRO DSP1400P

ULTRAMIZER®
PRO
MODEL DSP1424P
ULTRA-HIGH RESOLUTION
24-BIT DUAL ENGINE
DIGITAL MULTIBAND
LOUDNESS MAXIMIZER /
PROGRAM ENHANCER

BEHRINGER

POWER

IN / OUT
PRESET STORE
MIDI

EXCITER TUNE / HI MUTE
SUPER BASS TUNE / LO MUTE
CROSSOVER

LEFT
RIGHT
COUPLE

3D SURROUND STEREO WIDTH
DENOISER THRES. / SENS.

MAX. OUT LEVEL
ULTRAMIZER SPEED / RANGE

DUAL ENGINE PROCESSOR
24-BIT AD/DA CONVERTER
48 KHZ SAMPLING RATE

LEFT CHANNEL
RIGHT CHANNEL

User´s Manual

Bedienungsanleitung

E
D

Version 1.0   December 1998

BEHRINGER

www.behringer.de

CE

EC-Declaration of Conformity

BEHRINGER

INTERNATIONAL GmbH

acc. to the Directives
89/336/EWG and 73/23/EWG

We,   **BEHRINGER INTERNATIONAL GmbH**

Hanns-Martin-Schleyer-Straße 36 - 38

D - 47877 Willich

Name and address of the manufacturer or the introducer of the product on the market who is established in the EC

herewith take the sole responsibility to confirm that the product:

ULTRAMIZER PRO DSP1400P

Type designation and article-N° (if applicable)

to which this declaration refers, is in accordance with the following standards or standardized documents:

☒	**EN 60065**	☒	**EN 61000-3-2**
☒	**EN 55020**	☒	**EN 61000-3-3**
☒	**EN 55013**	☒	**EN 55022**

The following operation conditions and installation arrangements have to be presumed:

acc. to Operating Manual

BEHRINGER
INTERNATIONAL GmbH
Hanns-Martin-Schleyer-Str. 36-38
D-47877 Willich-Münchheide II
Tel.-Nr. 0 21 54 / 92 06-0
Fax-Nr. 0 21 54 / 92 06-30

B. Nier, President   Willich, 01.12.1998

Name, address, date and legally binding signature of the person responsible

SAFETY INSTRUCTIONS

CAUTION: To reduce the risk of electrical shock, do not remove the cover (or back). No user serviceable parts inside; refer servicing to qualified personnel.

WARNING: To reduce the risk of fire or electrical shock, do not expose this appliance to rain or moisture.

E

This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure - voltage that may be sufficient to constitute a risk of shock.

This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

DETAILED SAFETY INSTRUCTIONS:
All the safety and operation instructions should be read before the appliance is operated.
Retain Instructions:
The safety and operating instructions should be retained for future reference.
Heed Warnings:
All warnings on the appliance and in the operating instructions should be adhered to.
Follow instructions:
All operation and user instructions should be followed.
Water and Moisture:
The appliance should not be used near water (e.g. near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool etc.).
Ventilation:
The appliance should be situated so that its location or position does not interfere with its proper ventilation. For example, the appliance should not be situated on a bed, sofa rug, or similar surface that may block the ventilation openings, or placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.
Heat:
The appliance should be situated away from heat sources such as radiators, heat registers, stoves, or other appliance (including amplifiers) that produce heat.
Power Source:
The appliance should be connected to a power supply only of the type described in the operating instructions or as marked on the appliance.
Grounding or Polarization:
Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.
Power-Cord Protection:
Power supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords and plugs, convenience receptacles and the point where they exit from the appliance.
Cleaning:
The appliance should be cleaned only as recommended by the manufacturer.
Non-use Periods:
The power cord of the appliance should be unplugged from the outlet when left unused for a long period of time.
Object and Liquid Entry:
Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.
Damage Requiring Service:
The appliance should be serviced by qualified service personnel when:
- The power supply cord or the plug has been damaged; or
- Objects have fallen, or liquid has been spilled into the appliance; or
- The appliance has been exposed to rain; or
- The appliance does not appear to operate normally or exhibits a marked change in performance; or
- The appliance has been dropped, or the enclosure damaged.
Servicing:
The user should not attempt to service the appliance beyond that is described in the Operating Instructions. All other servicing should be referred to qualified service personnel.

ULTRAMIZER PRO

Ultra-high performance Digital Multiband Loudness Maximizer / Sound Program Enhancer powered by a 24-bit DSP
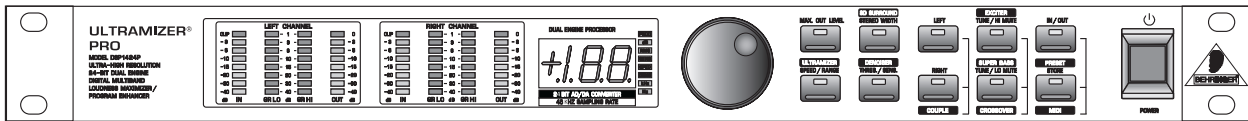
▲ Doubles the loudness of your Recordings and Sound Reinforcement Systems without any distortion

▲ Ultimate Mastering Machine maximizes signal energy with absolutely "inaudible" and transparent cmpression

▲ Variable band-split compression eliminates virtually any gain intermodulation effects, such as "bass pumping" etc.

▲ Multiband "Brickwall" Limiter protects against any clipping and dangerous sound pressure levels

▲ Built-in Denoiser and Exciter for noise-free and ultra transparent sound

▲ 3D Stereo Surround Processor provides unbelievable spatial enhancement and improved stereo imaging

▲ Super Bass Enhancer psycho-acoustically creates an incredible bass sound below your loudspeaker's frequency range

▲ Incorporated Leveler for constant average output level while retaining the instantaneous dynamics

▲ Free ULTRAMIZER software allows for total remote control via PC
  (download at www.behringer.de)

▲ 20-bit A/D and D/A Converters with 64/128 times oversampling for ultra-high headroom and resolution

▲ Internal 24-bit processing with professional 46 kHz sampling rate

▲ Servo-balanced Inputs and Outputs on gold plated XLR and TRS jack connectors for high signal integrity

▲ 50 user preset Memories to store programs for instant recall

▲ Accurate eight-segment LED Level and Gain Reduction meters for optimum performance

▲ "Future-proof" software-upgradeable architecture

▲ Full MIDI capability allows real-time parameter control and program selection

▲ High-quality components and exceptionally rugged construction ensures long life and durability

▲ Manufactured under the ISO 9000 management system

FOREWORD

Dear Customer,

Welcome to the team of ULTRAMIZER PRO users and thank you very much for expressing your confidence in BEHRINGER products by purchasing this unit.

It is one of my most pleasant tasks to write this letter to you, because it is the culmination of many months of hard work delivered by our engineering team to reach a very ambitious goal: making an outstanding device that will become a standard tool used by studios and P.A. companies. The task to design the ULTRAMIZER PRO certainly meant a great deal of responsibility, which we assumed by focusing on you, the discerning user and musician. It also meant a lot of work and night shifts to accomplish this goal. But it was fun, too. Developing a product usually brings a lot of people together, and what a great feeling it is when everybody who participated in such a project can be proud of what we've achieved.

It is our philosophy to share our joy with you, because you are the most important member of the BEHRINGER family. With your highly competent suggestions for new products you've greatly contributed to shaping our company and making it successful. In return, we guarantee you uncompromising quality (manufactured under ISO9000 certified management system) as well as excellent technical and audio properties at an extremely favorable price. All of this will enable you to fully unfold your creativity without being hampered by budget constraints.

We are often asked how we can make it to produce such high-grade devices at such unbelievably low prices. The answer is quite simple: it's you, our customers! Many satisfied customers means large sales volumes enabling us to get better conditions of purchase for components, etc. Isn't it only fair to pass this benefit back to you? Because we know that your success is our success, too!

I would like to thank all people whose help on "Project ULTRAMIZER PRO" has made it all possible. Everybody has made very personal contributions, starting from the designers of the unit via the many staff members in our company to you, the user of BEHRINGER products.

My friends, it's been worth the trouble!

Thank you very much,

Uli Behringer

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1. INTRODUCTION

The BEHRINGER ULTRAMIZER PRO is a digital sound processing device based on a sophisticated DSP, using 20 bit A/D and D/A converters. The high speed DSP is capable of performing the calculations needed for the complex algorithms in fractions of a second, the only element affecting its performance being the software. Despite extensive computing work which is done in the DSP1400P by a "dual-engine" 24-bit processor, the ULTRAMIZER PRO can be operated easily and conveniently. All parameter edits are performed with the jog wheel (rotary control). 50 presets are available to store user-defined programs.

☞ **The following operational manual will introduce you to the BEHRINGER ULTRAMIZER PRO and its various functions. After reading the manual carefully, make sure it is always on hand for future reference.**

1.1 The design concept

Contrary to analog technique, which has a limited response time capability, digital technology can look ahead to anticipate changes in incoming signals. The longer the look ahead, the more "intelligent" the response of the device or algorithm used.

You probably have heard a voice or solo instrument "disappearing" after a strong bass drum or bass line. This is a typical problem experienced by virtually every compressor. The level of a music signal is mostly determined by the bass signals. When the bass rises above the set threshold value of the compressor/limiter, the unit will reduce the gain, which is another way of saying that the overall level will be reduced to prevent the signal from becoming too strong. With that reduction in level, all other components like voices and instruments will also be reduced in level, making the sound muddy and dull.

This "drowning out" of voices and other instruments can be avoided if the frequency spectrum is divided in two parts. Each section can the be compressed or limited individually. The signals from the different compressors are then added up again to make up the complete spectrum again.

The ULTRAMIZER PRO divides the spectrum into two bands prior to performing the dynamic functions. This enables a very musical and effective compression of the program material signal. On top of that, the ULTRAMIZER PRO also features a highly effective Denoiser, an accurate and fast Peak Limiter, a 3D Surround Processor and a new Super Bass/Exciter for both low and high frequencies.

The philosophy behind BEHRINGER products guarantees a no-compromise circuit design and employs the best choice of components. Top-quality 20-bit AD/DA converters which belong to the best components available owing to its outstanding specifications and excellent sonic characteristics. A 24-bit DSPs is used as the heart of the ULTRA-CURVE PRO. It performs the precise calculations needed for the processing of the complex algorithms. Additionally, the VIRTUALIZER uses resistors and capacitors with very tight tolerances, high-grade switches, low-noise operational amplifiers (type 4580) as well as other selected components

The ULTRAMIZER PRO uses SMD technology (Surface Mounted Device). These subminiature components adapted from aerospace technology allow for an extreme packing density, improving the unit's reliability even further. Additionally, the unit is manufactured in compliance with a ISO9000 certified management system.

1.2 Before you begin

Your BEHRINGER ULTRAMIZER PRO was carefully packed in the factory and the packaging was designed to protect the unit from rough handling. Nevertheless, we recommend that you carefully examine the packaging and its contents for any signs of physical damage, which may have occurred in transit.

☞ **If the unit is damaged, please do not return it to us, but notify your dealer and the shipping company immediately, otherwise claims for damage or replacement may not be granted. Shipping claims must be made by the consignee.**

The BEHRINGER ULTRAMIZER PRO fits into one standard 19" rack unit of space (1 3/4"). Please allow at least an additional 4" depth for the connectors on the back panel.

☞ **Be sure that there is enough space around the unit for cooling and please do not place the ULTRAMIZER PRO on high temperature devices such as power amplifiers etc. to avoid overheating.**

The mains connection of the ULTRAMIZER PRO is made by using the supplied cable. It meets all of the international safety certification requirements. Please make sure that all units have a proper ground connection.

☞ **Before you connect your ULTRAMIZER PRO to the mains, please make sure that your local voltage matches the voltage required by the unit (see chapter 5.2 for details)!**

As a standard the audio inputs and outputs on the BEHRINGER ULTRAMIZER PRO are fully balanced. If possible, connect the unit to other devices in a balanced configuration to allow for maximum interference immunity. The automatic servo function detects unbalanced connections and compensates the level difference automatically (6 dB correction).

The MIDI links (IN/OUT/THRU) are made over standardized DIN patch cords. The data communication is isolated from ground by an opto-coupler.
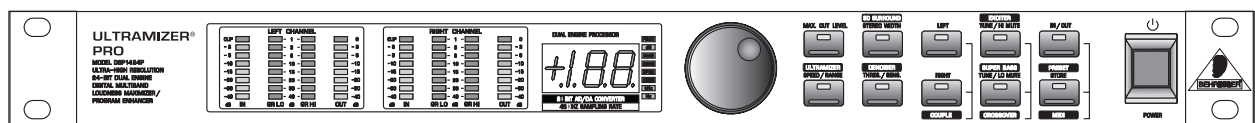
1.3   Control elements

Fig. 1.1: ULTRAMIZER PRO front panel

The BEHRINGER ULTRAMIZER PRO is equipped with ten illuminated parameter keys, one jog wheel (rotary control), a numeric display, 8 LED indicators and a power switch. Each of the two fully independent channels can be monitored with four 8-stage LED meters, displaying input level, output level and gain reduction for both bands.

1.3.1   Front panel
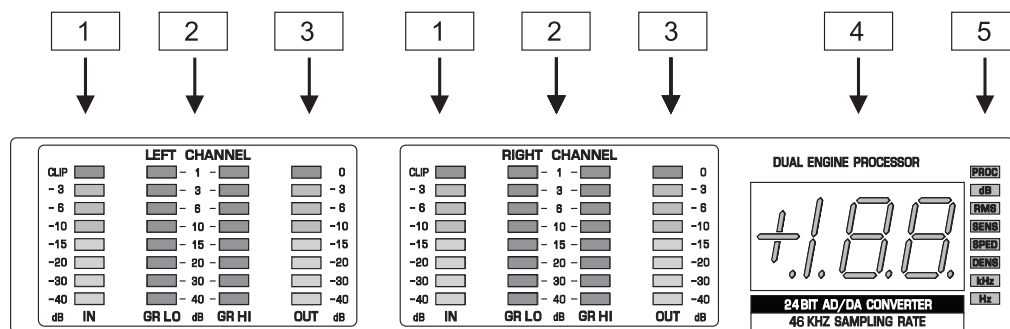
Fig. 1.2: Display section DSP1400P

[1]   The two *LED* chains read the input signal level in dB, referenced to the internal digital maximum.

☞ **Please note that the nominal level of the ULTRAMIZER PRO can be selected with the +4 dBu / -10 dBV switch located on the back panel. (see 3.1 "Level setting")**

[2]   The gain reduction meters show the applied gain reduction. Gain reduction is shown for both frequency bands. *GR LO* shows the gain reduction in the lower and *GR HI* in the higher frequency band.

[3]   These two *OUT LED* chains read the output signal level in dB, referenced to the maximum output level of +15 dBu.

[4]   After power-up, the *LED* display reads the number of the preset last used. This clearly legible, 2½ digit numeric display has plus/minus indicators to show that parameters are being incremented or decremented in Edit mode.

5   Next to the display, the appropriate unit lights up to indicate the correct value which is being edited. These eight LED illuminated units are very important with keys which can represent more than one parameter.

Fig. 1.3: Function keys and jog wheel

6   With the *jog wheel*, a continuous rotary control, you can freely edit the selected parameters. Turn the wheel clockwise to increase the values or counter-clockwise to reduce them.

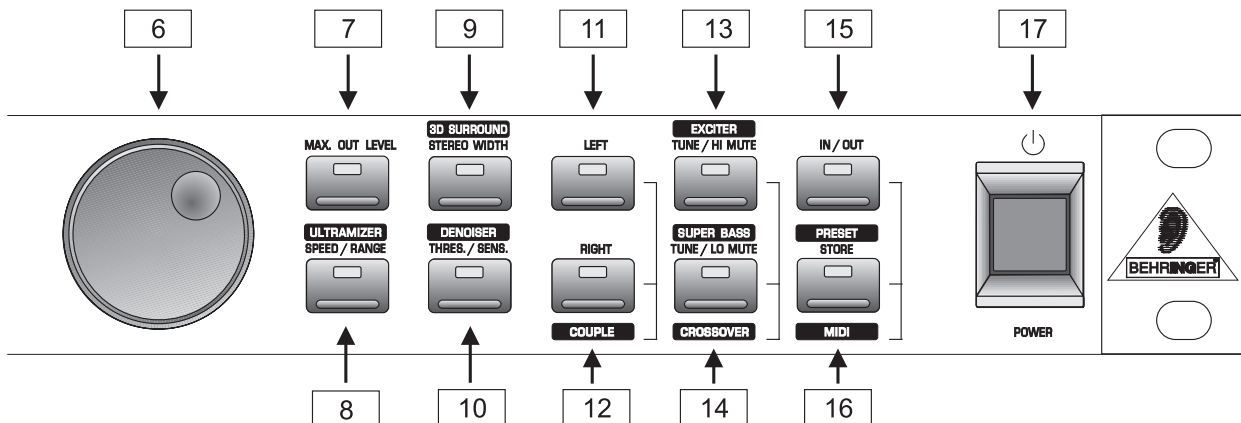☞ **When you press the PRESET key once, you can use the wheel to select a program directly, which is shown by a dot lighting up in the display. While this dot is on, you can select a program though its settings will not take immediate effect. When the jog wheel has not been touched for a short time, the LED in the display disappears and the program is loaded.**

7   Use the *MAX. OUT LEVEL* to set the output limiter. This value can be set from -48 to 0 dB. The dB value will light up next to the numeric display. You can change the MAX. OUT LEVEL parameter from peak to RMS mode by pressing the MAX. OUT LEVEL key for about 2 seconds. RMS means the setting of an average level for the MAX. OUT LEVEL parameter. Peak stands for a peak value. To make clear that you are in RMS mode "RMS" will light up in the display.

8   The Ultramizer function enables you to maximize the perceived loudness of the program material. The *ULTRAMIZER* key gives you access to three parameters:

a) When pressed once the DENSITY ("DENS" will light up in the display) can be adjusted. The subjectively felt density of the program material is the result of the amount of compression that is applied. The DENSITY can be adjusted from 0 (no compression) to 100 (extreme dynamic gain reduction).

b) Pressed a second time, the SPEED of the Ultramizer function can be set ("SPED" will light up in the display). This parameter is very important for the dynamic behavior which depends on the application. Generally low SPEED settings are suited if the ULTRAMIZER is to work rather "inaudibly". Higher SPEED is required when short level changes should be levelled.

c) Pressed third time, the RANGE can be set ("dB" will light up in the display). This parameter determines the maximum amplification the Ultramizer function may use in order to achieve the desired DENSITY and MAXIMUM OUTPUT LEVEL. The value can be adjusted from 0 to 24 dB.

For further information on the Ultramizer function please refer to section 2.1.1.

9   Use the *3D SURROUND* key to increase the stereo width of the signal. Setting can range from 0 (no processing) to 100.

10   With the *DENOISER* key you have access to two parameters which influence the process.

a) When pressed once the *THRESHOLD* of the Noise Gate can be set ("dB" will light up in the display). The value ranges from -90 dB to 0 dB. "OF" means the Denoiser function is deactivated.

☞ **Please bear in mind that when the threshold number displayed is small, the threshold level in fact is high and consequently only loud signals will pass through. When the value is lowered to -100 dB for example (referring to the digital maximum) every signal will pass.**

b) When pressed a second time the *SENSITIVITY* can be adjusted ("SENS" will light up in the display). This governs the sensitivity of the dynamic high cut filter and how it reacts to the input signal. The value ranges from 0 to 100.

⑪ When the *LEFT* key is pressed only the settings for the left channel are edited.

⑫ Use the *RIGHT* key to select the right audio channel.

☞ **If you wish to process the left and right audio channels simultaneously (*COUPLE* mode), press both LEFT & RIGHT keys together. In couple mode both key LEDs light up. Whenever you edit one of the two audio channels and then switch to couple mode, the parameters of the active channel will be copied to the other; i.e. if you press LEFT before RIGHT, left will be copied to right.**

⑬ The *EXCITER* key has three functions:

a) *PROCESS,* ("PROC" will light up) when pressed once the intensity of the Exciter function can be adjusted ranging from 0 to 100.

b) Pressed a second time the *TUNE* parameter can be set ("kHz" will light up). The TUNE control sets the lower cut-off frequency of the Exciter function. The cut-off frequency can be adjusted within a range of 4 to 12 kHz.

c) The third function is reached by pressing the *EXCITER* key for more than 2 seconds. The upper frequency band is then muted. This is indicated by a full LED bar that flashes on and off (GR HI). This function is useful when you want to monitor the processing of the ULTRAMIZER PRO. Alternatively the unit can also be used as a crossover to generate a subwoofer signal for instance.

⑭ The *SUPER BASS* key has three functions:

a) *PROCESS, w*hen pressed once the intensity of the Super Bass function can be adjusted ranging from 0 to 100 ("PROC" will light up).

b) Pressed a second time the *TUNE* parameter can be set ("Hz" will light up). Here the TUNE control sets the upper cut-off frequency of the Super Bass function. The cut-off frequency can be adjusted within a range of 50 to 150 Hz.

c) Again the third function is reached by pressing the SUPER BASS key for more than 2 seconds. The lower frequency band is now muted. This is indicated by a full GR LO LED bar that flashes on and off.

☞ **When the EXCITER and SUPER BASS keys are pressed simultaneously, the crossover frequency, between – the lower and higher bands of the multiband compressor – can be adjusted from 20 Hz to 20 kHz.**

⑮ The *IN/OUT* key enables you to bypass the DSP1400P. The green LED lights up as soon as the ULTRAMIZER PRO is activated.

⑯ Whenever a setting has been changed the *PRESET* key starts to blink slowly, indicating that a preset has been changed but not stored. When the PRESET key is pressed once the current preset number is shown in the numeric display. When the PRESET key is pressed again the current preset number starts flashing, you can then select any of the 50 memory locations. Press a third time to save the edited program to a user preset as shown in the display.

☞ **When the IN/OUT and PRESET keys are pressed simultaneously the ULTRAMIZER PRO enters the MIDI menu, where all MIDI settings can be edited.**

17   Use the *POWER* switch to switch the ULTRAMIZER PRO on or off.
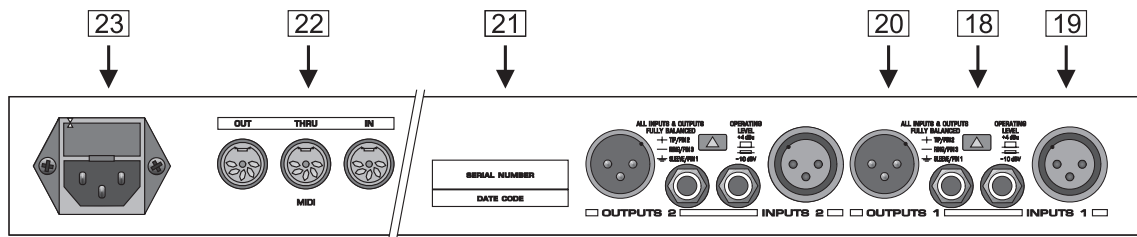
1.3.2 Back panel

Fig. 1.4: Back panel connectors and control elements

18   Use the *OPERATING LEVEL* switch to adapt the ULTRAMIZER PRO to different operating levels. You can select a -10 dBV semi-pro level used for home recording and a +4 dBu level used in professional studios. This way the ULTRAMIZER PRO is always optimally adapted to the used nominal operating level.

19   These are the ULTRAMIZER PRO's analog *INPUTS.* The ULTRAMIZER PRO has both XLR and jack inputs and outputs. Each XLR and jack set is wired parallel and can be used either balanced or unbalanced.

20   These are the ULTRAMIZER PRO's analog *OUTPUTS*. Also on balanced or unbalanced XLR or TRS jacks.

21   Please take the time to complete the enclosed Warranty Registration Card. Put the instruction manual in a safe place and return the completed Warranty Registration Card to us within 14 days of purchase, making sure that the dealer stamp has been acquired.

22   These are the ULTRAMIZER PRO's MIDI connectors (*MIDI OUT / THRU / IN*). Via these connectors total remote control is possible.

23   This is the *MAINS CONNECTOR / FUSE HOLDER / VOLTAGE SELECTOR.* Before you connect the unit, please make sure that the displayed voltage corresponds to your Mains supply. Please note that the AC voltage selection is defined by the position of the Fuse Holder. If you intend to change the operating voltage, remove the Fuse Holder and turn it by 180 degrees before you reinsert it. Matching the two markers monitors the selected voltage. Please note that, depending on the mains voltage supplied to the unit, the correct fuse type and rate must be installed (see chapter 6.2 "Specifications"). Please use the enclosed mains cable to connect the unit to the mains power supply.

☞ **Please note that not all appliances can be used with different mains voltage ratings. Please check the description on the back of the unit and the box.**

1.3.3 Restoring factory defaults

To protect the DSP1400P against user errors, an important edit command has been implemented via a particular key combination. In normal operating mode the presets cannot be reset to their factory defaults, so as to secure your own programs as safely as possible. Please proceed as follows to reinitialize the preset default settings:

☞ **Press and keep the keys Effect and PRESET** *before powering up* **the ULTRAMIZER PRO. Then switch on the DSP1400P and keep the two keys pressed for about two seconds. The program numbers are counted up and reset to their original default settings.**

2. OPERATION

The ULTRAMIZER PRO is one of the latest generation digital processing devices. Especially designed for processing the total mix or complex music signals. BEHRINGERs past experience in digital and analog processing devices come together in this new device. In the DSP1400P, the advantages of digital technology

go hand in hand with the warm and powerful sound of analog devices. The ULTRAMIZER PRO combines multiple functions for the processing of stereo signals in one device. It is a multi-band Compressor, a 3D-Surround Processor, a Denoiser as well as an Exciter and a Bass Processor. Despite this unbelievable processing power the DSP1400P can be intuitively operated with an audio quality previously unimaginable.

2.1.1 The Ultramizer function

With the Ultramizer function you can increase the loudness and density of the program material. The DSP1400P analyzes the received music material and adapts the settings automatically. The function of the Ultramizer is dependent on the the setting of the RANGE parameter. When the RANGE parameter is set relatively high, the Ultramizer function will perform these two actions:

▲ The Ultramizer function adjusts the parameters of the compressors to achieve the desired (set) DENSITY in both bands.

▲ The total volume is raised to the MAX OUT LEVEL. The total gain is adjusted in a way that the output limiter will have a slight gain reduction. All relative parameters are continuously monitored to keep the DENSITY at whatever level you have set.

When the RANGE parameter is set at zero or a small value, the total output will not increase (or only slightly increase). Only the DENSITY will be increased, resulting in a gain reduction at the output. This setup is advisable when an increase of the gain is unwanted, for instance in live applications where an unexpected increase in gain can lead to feedback.

ULTRAMIZER DENSITY
After pressing the ULTRAMIZER key once, you have access to the parameter DENSITY. DENSITY is a combination of parameters governing the perceived density of the signal.

ULTRAMIZER SPEED
After pressing the ULTRAMIZER key a second time, the parameter SPEED can be set. This is the relative speed with which the parameters of the compressor, limiter and gain at the input will be altered to adapt to the incoming audio. Choose a low speed when the Ultramizer function must do its job inaudible and high speed when fast recovery from transients is needed. When low speeds are chosen the Ultramizer function will adapt slowly to new incoming signals, although the limiter will still perform as a "brick wall" limiter which will affect transients.

ULTRAMIZER RANGE
The parameter RANGE, which you access after pressing the ULTRAMIZER key three times, determines the maximal gain the Ultramizer function will apply to the signal. This way, fade ins and fade outs remain unaffected. It is even possible to set this value to zero so that no amplification is allowed but the density will increase when a high enough level is applied to the input. When the applied signal reaches the MAX OUT LEVEL the signal will be compressed and limited by the multiband compresser and the output limiter. This will prevent distortion while maximizing the loudness, without the risk of feedback caused by an increase in gain during the quiet(er) moments. This function is particularly useful when using the ULTRAMIZER PRO live, where unexpected gain increase may cause feedback. The RANGE can be set from 0 to 24 dB.

2.1.2 The Max. Out Level function

Integrated in the design of the ULTRAMIZER PRO is its limiter function. Key value in almost all functions is the maximum output level that is set here. This value is a so called "brick wall" that cannot be exceeded under any circumstances when the ULTRAMIZER PRO is engaged. The level can be set from -48 dB to 0 dB, with reference to the internal digital level ("dB" will light up in the display). 0 dB corresponds to +16 dBu. This level is simply set by the following steps:

1. Set the MAX OUT LEVEL to a low value.

2. Apply a signal to the input of the ULTRAMIZER PRO that is loud enough to be limited constantly.

3. Slowly turn the MAX OUT LEVEL up until the clip LEDs of the connected power amplifier light up occasionally.

After determining the correct MAX OUT LEVEL the preset can be stored to recall at any time the same amplifier and speakers are used.

You can adjust the MAX. OUT LEVEL parameter in two different ways: The peak and RMS mode. In peak mode you can adjust a maximum peak value which will not be exceeded. In RMS mode you set an average

maximum level. You can switch between these two modes by pressing the MAX. OUT LEVEL key for about 2 seconds. Additionally the "RMS" LED in the display will light up.

2.1.3 The Exciter function

The ULTRAMIZER PRO's Exciter function adds transparency and depth to the audio signal. Classical music material gains transparency and musicality while popular music keeps the desired brilliance. Two parameters govern the performance of the Exciter function, both can be accessed by means of the EXCITER key.

EXCITER PROCESS
When pressed once you gain access to the Exciter PROCESS parameter. The "PROC" LED next to the numeric display will light up to show this. Now you can set the intensity of the Exciter effect within the range of 0 to 100.

EXCITER TUNE
When pressed twice you have access to the TUNE parameter. Here this is the lower frequency limit of the Exciter function. This can be set from 4 to 12 kHz. The "kHz" LED beside the numeric display lights up to display the unit of the edited parameter.

2.1.4 The Super Bass function

The Super Bass function is the low frequency equivalent of the Exciter function. Designed to process the low frequency portion of the signal and to add transparency and depth.

SUPER BASS PROCESS
If you press the SUPER BASS key once you can access the Super Bass PROCESS parameter, which determines the intensity of the Super Bass function. The value can be set from 0 to 100 while the "PROC" LED lights up.

☞ **Be careful not to overload your power amplifiers or loudspeakers when you use an extreme setting of the PROCESS parameter of the Super Bass function. Remember, less is more.**

SUPER BASS TUNE
When pressed twice you have access to the Super Bass TUNE parameter. This is the upper frequency limit of the Super Bass function.This can be set from 50 to 150 Hz. The "Hz" LED beside the numeric display lights up to display the unit of the edited parameter.

2.1.5 The 3D Surround function

With the the 3D Surround function the ULTRAMIZER PRO can be used as a 3D stereo Surround Processor, increasing the stereo width of the program material. Whether you want to process individual instruments or the entire mix, you can set the 3D Surround function "on the fly". The effect makes the sound more spacious, wider and more full. Since this function does not make any sense with two mono signals, the COUPLE mode must be activated to activate the 3D Surround function

☞ **When you use extreme setting with the 3D Surround function on heavily reverberated audio material, the reverb can sound unnatural and too intense. This is caused by the way stereo reverbs operate. Remember, less is more.**

2.1.6 The Denoiser function

The ULTRAMIZER PRO's Denoiser function is universally applicable and suited for all types of instrument and complex signals. The algorithm of the Denoiser function does not produce unpleasant side effects like pumping or noise trails. The parameters are for a large part chosen automatically depending on the program material and the two parameters, which can be accessed with the DENOISER key.

DENOISER THRESHOLD
When the DENOISER key is pressed once, the THRESHOLD can be set. This function reflects the Noise Gate and is used to remove unwanted noise during the pauses. When the Denoiser THRESHOLD is being set the "dB" LED beside the numeric display lights up. The setting can range from -90 dB to 0 dB (no signal reaches the output). "OF" means the Denoiser function is deactivated.

DENOISER SENSITIVITY
When the DENOISER key is pressed twice you can edit the parameter SENSITIVITY. With this parameter

you determine the sensitivity of the dynamic high cut filter. This function is highly useful to remove noise from the music signal. To indicate that the sensitivity is being edited the "SENS" LED beside the numeric display lights up.

☞ **The optimal adjustment of the SENSITIVITY parameter depends strongly on the type of noise and program material. Take the time to set the SENSITIVITY parameter with care.**

2.1.7 The Crossover parameter

The advantage of multiband processing is in the division of the audio spectrum into several bands, in order to avoid the negative effects of spectral intermodulation. The choice of the crossover frequency which divides the bands has influence on how the processing takes place. With complex composite signals the crossover frequency should be in the bass area (±200 Hz e.g. in order to prevent modulation of the mid and high frequency range by the energy produced in the bass area). With single instruments and vocals however, a higher crossover frequency is more desireable (2 kHz), since the center point of the power spectrum is shifted here.

For complete flexibility the crossover frequency can be set anywhere from 20 Hz to 20 kHz, in 31 steps according to the ISO frequencies. This enables the ULTRAMIZER PRO to be used not only as a mastering device but also as a processor for single instruments and vocals. If you set the crossover frequency to the maximum or minimum value (20 Hz or 20 kHz), the ULTRAMIZER PRO will operate as a broadband compressor.

Feel free to experiment with different crossover frequency settings and pretty soon a feeling for the right setting will arise, making the ULTRAMIZER PRO that much more effective and useful.

2.2 Selecting presets

The ULTRAMIZER PRO stores 50 user-definable presets. After power-up, the unit automatically recalls the preset last used. To select another preset, make sure that the PRESET key is pressed once. Use the jog wheel to enter the preset number of your choice. Turn the wheel clockwise to increment the preset number, or counter-clockwise to decrement it.

☞ **Please note that the ULTRAMIZER PRO generally activates the newly selected presets only after about one second, which is indicated by a dot in the lower right corner of the display. After loading the data, the ULTRAMIZER PRO enables the preset and the dot disappears. This brief interruption avoids the direct activation of every preset, as you scroll through the preset list with the jog wheel. Thus, the ULTRAMIZER PRO makes sure that no "unwanted" presets are loaded unintentionally. Additionally, you can rotate the jog wheel at high speed and still have the time to specifically select the preset of your choice, instead of any of its "neighbors".**

2.3 Editing presets

Editing presets is easy on the ULTRAMIZER PRO. Basically, all essential parameters can be selected directly via the keypad and edited with the jog wheel. Some key have multiple function that can be accessed by pressing that particular key repeatedly.

Use the LEFT and RIGHT keys to edit the left or right audio channel settings. Of course, you can edit both channels at the same time in COUPLE mode.

☞ **Whenever you edit one of the two audio channels and then switch to couple mode, the parameters of the active channel will be copied to the other; i.e. if you press LEFT before RIGHT, left will be copied to right. Finally, you can also save the edits made to the preset.**

2.4 Saving presets

Use the PRESET key to save an edited preset. Basically, all parameter changes can be saved. Whenever you're editing a preset, the display starts flashing to indicate that the edits will be saved only when you confirm them by pressing the PRESET key twice. Example:

▲ You recall a preset for editing. Then you edit the preset as desired using the function keys and the jog wheel. During this process, the flashing PRESET key reminds you that the preset settings have been changed but not saved yet. Press the PRESET key once. The display reads the current preset number. When pressed again this number starts flashing. To keep the original preset, use the jog wheel to select

another preset that can be overwritten. Press the PRESET key a third time to save the edits to the selected preset. If you wish to overwrite the original preset, simply press the PRESET key three times (after editing) to save all changes you have made.

☞ **Whenever you have edited a preset and pressed the PRESET key three times, all previous settings in this preset are erased and overwritten with the new parameter values. However, if you wish to keep the original preset, use the jog wheel to select another preset *before* you press the PRESET key a third time.**

2.5 MIDI control

Use the MIDI key combination to select the MIDI parameters you wish to adjust. For this purpose press and keep the IN/OUT and the PRESET keys for about two seconds. All parameters can be edited with the jog wheel and the IN/OUT key. The MIDI menu includes six pages which you can select by pressing the IN/OUT key (forwards) and the PRESET key (backwards) several times.

On the first page you can select the MIDI channel. The display reads a small "c" (= channel). The jog wheel adjusts a channel from 1 through 16. To switch off the MIDI function simply select the "0" value (displayed as "-").

On the second page you can select MIDI Omni mode, i.e. the unit transmits/receives on all 16 MIDI channels. The display reads "O" (=Omni). Use the jog wheel to activate ("1") or deactivate ("0") Omni mode.

The third page allows for configuring controller commands. On its right-hand side, the display reads a capital "C" (=Controller). The jog wheel selects one of the following four controller modes:

Display	Mode
0	No controller data is transmitted
1	Controller data is received but not transmitted
2	Controller data is transmitted but not received
3	Controller data is transmitted and received

Tab. 2.2: Controller settings

The fourth page gives you access to the program change setup. The display reads a capital "P" (=Program). Here, too, four modes can be selected with the jog wheel, as follows:

Display	Mode
0	No program change data are transmitted
1	Program change data are received but not transmitted
2	Program change data are transmitted but not received
3	Program change data are transmitted and received

Tab. 2.3: Program change settings

The fifth page of the MIDI menu shows the "store enable" flag represented by a capital "S" in the display. The value "0" disables the reception of controller #86, and therefore protects the user presets from being modified via MIDI. Accordingly, the value "1" enables MIDI controller #86 so that you can modify or replace presets with a remote MIDI device or a sequencer. In this case the actual settings will be stored directly to the location that corresponds to the controller value.

☞ **Attention! Since the "store enable" mode allows you to access memory locations directly via MIDI, it is possible that stored presets will be replaced or altered if controller #86 messages are sent on the same MIDI channel. The purpose of this mode is to facilitate MIDI backup and restore operations without express confirmation at the ULTRAMIZER PRO. It is therefore recommended to disable (flag=0) this mode as soon as the intended data transfer has ended. This is done automatically when you switch off the ULTRAMIZER PRO.**

On the sixth page you can access the "System Exclusive" functions. This is indicated by a "d" (for dump) in the display. To the left of this "d" a number is displayed:

"d0" means that no SYSEX data will be sent or accepted. "d1" will enable the ULTRAMIZER PRO to receive data. When PRESET is pressed the unit will wait for data, this is shown by flashing dots (LEDs) in the display. The MIDI button LED flashes signaling that SYSEX data is being received. "d2" will enable the ULTRAMIZER PRO to send a "bulk dump". Start your sequencer and press PRESET on the unit to start the transmission.

If you press the IN/OUT key again on the sixth page, the ULTRAMIZER PRO quits MIDI setup mode.

To load these settings again, select "d1", press PRESET and start your sequencer. If you press IN/OUT again, you will leave the MIDI setup. You can at all times press any other key to leave the MIDI setup directly.

☞ **During a bulk dump all audio functions of the ULTRAMIZER PRO will be deactivated.**

The full-featured MIDI implementation of the ULTRAMIZER PRO allows for easily integrating the ULTRAMIZER PRO into any MIDI system. For detailed information on controller tabs please refer to section 6.1.

▲ MIDI IN

Any MIDI data sent to the ULTRAMIZER PRO (sequencer, MIDI footswitch, etc.) are received via the MIDI IN jack. For example, if you wish to use the ULTRAMIZER PRO as an effects device for your guitar rack, you can connect the MIDI IN jack to a MIDI footswitch that allows for selecting program presets. If your rack includes another MIDI effects device (e.g. a multi-effects processor), the data sent from the MIDI footswitch can be routed via the ULTRAMIZER PROs MIDI THRU jack to your multi-effects processor.

▲ MIDI THRU

The MIDI THRU jack is used to loop through incoming MIDI data, i.e. any control data received at the MIDI IN of the ULTRAMIZER PRO will be transmitted via the MIDI THRU jack to other MIDI devices/instruments.

▲ MIDI OUT

The MIDI OUT jack allows for transmitting MIDI data that originate from the ULTRAMIZER PRO. We are currently developing a software editor which will allow for storing single items of the unit`s internal data on an external medium. Thus, it will be possible to archive ULTRAMIZER PRO settings and presets on a computer, sequencer or MIDI data recorder. Both MIDI Control Change and MIDI Program Change commands will be transmitted when you edit or recall filter settings. Detailed information on this future software editor are available from our BEHRINGER hotline (tel. +49 (0) 2154-920666), our international distributors and/or our Internet homepage http://www.behringer.de.

3. APPLICATIONS

The BEHRINGER ULTRAMIZER PRO features a high level of flexibility. The following chapter describes some other possible applications for your ULTRAMIZER PRO.

3.1 Level setting

Take care to set levels properly on the ULTRAMIZER PRO! Low levels deteriorate the dynamics of the music signal, which results in a poor, weak and noisy sound. On the other hand, excess levels overdriving the converters in the ULTRAMIZER PRO should also be avoided. Digital distortion is (unlike its analog counter-part) very unpleasant to hear as it does not occur gradually but abruptly.

Use the input level meter of the ULTRAMIZER PRO to adjust the input signal to about -10 dB. Make sure that the CLIP LED never lights up!

3.2 Using the ULTRAMIZER PRO in a studio environment

With its highly flexible configuration the ULTRAMIZER PRO also delivers good results in a professional studio or home recording environment. When used as a mastering device while recording or copying the ULTRAMIZER PRO should be placed between source and recorder as shown in fig 3.1. You can realize any application ranging from slight processing to the total manipulation of music signals. For example, you can use the ULTRAMIZER PRO as a Loudness Maximizer, Limiter and the Denoiser system at the same time when copying analog tapes.

3.2.1 The ULTRAMIZER PRO in analog recording

In the recording and duplication field the goal should always be to achieve an optimum recording level onto the recording media. Too low or too high recording levels lead to side effects such as noise, distortion etc. In mastering and multitrack recording, as well as in duplication, one should always take care to utilize the full dynamic range of the tape recorder, DAT recorder etc. Principally, it is possible to control the recording level by "riding" faders, which means with low level signals, the gain is increased, whereas the amplitude of high level signal is reduced. It is obvious that this method is insufficient because, especially in live recordings, the expected signal levels cannot be anticipated correctly. Especially with multitrack recordings, which are run under hectic circumstances, the signal level of all channels cannot be monitored and controlled at the same time. Generally, with manual control, it is not possible to achieve satisfying recording results.

An automatic gain control system achieves better and more constant results. Use the ULTRAMIZER PRO by starting with the initial settings, and use its dynamic control functions in order to be able to drive an analog, as well as a digital recording, up to the limit of its maximum dynamic range while remaining noise- and distortion-free.

3.2.2 The ULTRAMIZER PRO in digital recording and sampling

In an analog recording, too low recording levels lead to an increased noise level, whereas too high levels will cause a compressed and "squashed" sound. In extreme cases, it will cause distortion due to tape saturation. In contrast to analog, side effects in the digital field always become extremely audible: with decreasing level, a tape previously recorded with insufficient level loses resolution: the recording sounds "hard" and loses "atmosphere". With excessive level, the recording sounds harsh and heavily distorted. In order to avoid these effects, the Peak Limiter section of the ULTRAMIZER PRO should be placed before for example a sampler. The Peak Limiter is set with the MAX OUT LEVEL value. As a result of this process, a digital recording or a sampling event can be optimally set in level without any problem.

3.2.3 The ULTRAMIZER PRO in mastering
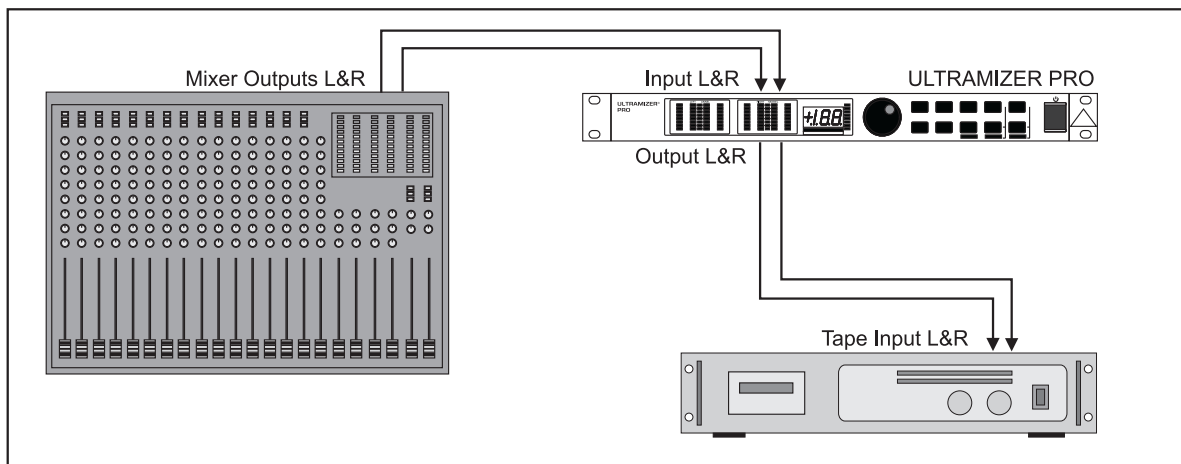
Fig. 3.1: The ULTRAMIZER as mastering device

The mastering process is one of the most critical processing steps in recording. In this production step, it is the goal to achieve a "maximum level" copy of the recording, without any noise or distortion. In many applications it is further required to produce a high average volume. Quite often in these cases, dynamics suffer drastically, because the program material has been compressed and limited too heavily. Using the Compressor and the Peak Limiter section of the ULTRAMIZER PRO allows you to drastically increase the overall volume, without audibly affecting the dynamics.

Proceed as follows:

1. Limit the dynamics of the program material by 6 dB using the Peak Limiter section. By softly clipping just the transients, the real audio signal will not be limited, resulting in a higher headroom. The overall gain can now be increased by 6 dB, which leads to a higher volume. More than 6 dB should not be limited,

otherwise side effects could become audible.

2. Therefore, in addition, you should also use the ULTRAMIZER function. It is recommended that the compression is limited to the "first" 6 dB of the dynamic range only. You can monitor the gain reduction with the help of the GR LO and GR HI gain reduction meters.

The "cut" signal peaks cause a reduced recording level of about 6 dB, which is visible on the level indicators of the DAT recorder. Now increase the recording level of the recorder back to normal. The result is a louder recording without any loss of sound.

3.3 The ULTRAMIZER PRO as a protective device

Sound system distortion is usually a result of amplifiers and loudspeakers being driven beyond their limitations, whereby signals are hard limited by so-called "clipping" of the amplifiers. The signal peaks are thereby "clipped" because the maximum output voltage is reached, which leads to unpleasant and for loudspeakers dangerous distortions.

Apart from the danger of long term overload a loudspeaker can also be damaged by an occasional high level overload, e.g. the sound of a microphone falling onto a hard floor. In order to protect a system or the loudspeakers, the application of the BEHRINGER ULTRAMIZER PRO is recommended. Conventional limiter must restrict the maximum output level far below the clip-point of the amplifier, in order to limit the height and duration of overloading transients. This has the disadvantage that the power reserve of the system cannot be fully exploited.
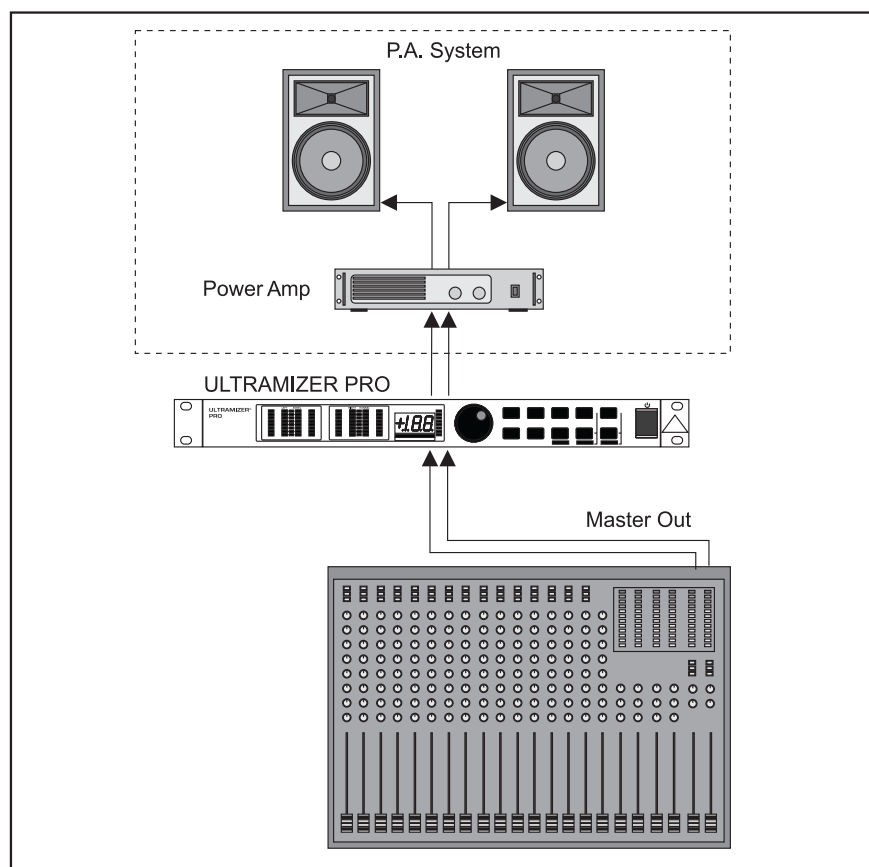
Fig. 3.2: Using the ULTRAMIZER PRO in the main mix bus

3.3.1 Protection of a system with a passive crossover

If your sound system incorporates a passive crossover network (included in the loudspeaker case), insert the BEHRINGER ULTRAMIZER PRO between your mixing console output and the power amplifier input. It is used as the last link in the chain preceding the power amp. Thus, you can effectively avoid damage to the midrange/tweeter range caused by clipping of the high-energy bass signals. This statement, as paradoxical as it may

seem at first, can be explained with the fact that especially low-frequency signals with high amplitudes can overload the power supply in the amplifier(s). The resulting clipping (cutting off of signal peaks) produces distortion (upper harmonics), which is abruptly added to the midrange/tweeter signals. For this reason, "weak" power amps, in particular, must be protected by a limiter in their input dynamics.

3.3.2 Protection of a system with an active crossover

When used with a system with an electronic crossover, connect the ULTRAMIZER PRO before the crossover. In this application, the BEHRINGER ULTRAMIZER PRO will process the entire audio frequency spectrum.

☞ **If you want to protect one or more separate units or in a multi-way active system you can use a (multi)way compressor/limiter between the electronic crossover and the amplifier(s) like the BEHRINGER MULTICOM PRO MDX4400.**

3.3.3 Improving the sound of a processor system

An electronic crossover divides the total frequency spectrum in separate bands, corrects the single units's frequency responds and time alignment. A processor system is a PA system which contains a special active crossover which additionally dynamic functions that monitor the system performance and optimize the output dependend on the program material. Each band has its own limiter whose task it is to limit dangerous signal peaks to a certain level. This process avoids overloading the subsequent power amplifier or destruction of the loudspeaker.

In some units a "loudness contour" is applied where for instance the bass is boosted at low levels to extend the range of the system at the low end. At higher level this frequency correction is abandoned in exchange for a higher maximum sound pressure level. In many cases, this function leads more to a disturbance than to an improvement of the sound quality.

If the ULTRAMIZER PRO is placed before the processor, the signal peaks can be eliminated before they reach the limiters of the processing system. The sound quality therefore remains natural and free of side effects caused by the dynamic functions of the crossover.

3.4 The ULTRAMIZER PRO in combination with a multitrack

In connection with multi-track machines the BEHRINGER ULTRAMIZER PRO can be used to prevent distortion caused by saturation and to minimize tape hiss. Adjustment is fairly straight forward, maximum level is easily determined and for the same kind of tape fixed. Limiting the audio level enables a higher nominal level of the recording, with a dramatically improved signal-to-noise ratio.

3.5 The ULTRAMIZER PRO in broadcast

The main aim of processing sound recordings for commercial radio and television is to achieve a maximum transmission volume.

What is volume?

Volume is defined as the relationship between the average level of program material to peak-to-peak level, in response to amplitude and duration. The higher the average level and the time it remains at a high level, the louder the program material will be perceived by the listener.

If you want to run your broadcast station at maximum average volume, proceed as mentioned in chapter 3.2.2. Please make sure that the maximum peak level is below the threshold of the transmitter's limiter, otherwise this could lead to very hard and audible use of the transmission limiters. Keep in mind that a heavy increase in average volume by means of compression always leads to a loss in dynamics and an increased perception of side effects. The moderate use of the ULTRAMIZER PRO results in higher average volumes, free of distortion.

Due to the multiband processing, the ULTRAMIZER PRO is capable of processing entire audio signals inaudible to protect subsequent devices. With same or higher, subjective volume signal processing by the ULTRAMIZER PRO is felt as a clear sound improvement, without the transmitter's limiter responding. Digital devices are well suited to handle the large dynamic range of classical music. For broadcasting however this is not desired. Ambient noise, people talking in a restaurant, wind noise in a car etc., can drown out quiet pieces of the music very easily. The ULTRAMIZER PRO raises these pieces in volume without falsifying

dynamics and transients audibly.

With television broadcasts varying volume levels can cause problems: Announcements, jingles, dialog and background music can differ strongly in level. Here too the ULTRAMIZER PRO can level out these differences in the program material and can thus provide a constant volume. Moderate use of the Compressor, Peak Limiter, Super Bass and Exciter section of the ULTRAMIZER PRO will help to achieve high and distortion-free nominal volumes without loss of liveliness.

3.5.1 AM/TV broadcasting

AM broadcast has clearly limited transmission bandwidth and relatively limited dynamics. The goal is to limit the signal dynamics in such a way that the transmitted power is as constant as possible. The ULTRAMIZER PRO permit the optimal use of the individual frequency bands continuously to optimize, in order to use the band-width limited anyway and the signal-to-noise ratio permanently, close at the maximum. FM broadcast is more sensitive to signal processing due to the larger bandwidth and dynamics . Most commercial transmitters want to transmit with the highest obtainable average level and use a multiplicity of signal processors to achieve this. This despite the effects on the quality of the program material.

If a limiter with active pre-emphasis is used, the ULTRAMIZER PRO should be placed directly before it. That way the transmitter's subsequent limiter is limits the signal less resulting in an improved overall sound. As TV sound is usually also transferred in FM, the same goes for processing TV sound.

3.5.1 Telephone lines and wireless systems

The ULTRAMIZER PRO can dramatically improve the signal to noise ratio of telephone lines and wireless systems while at the same time guarding subsequent devices against overload. They produce an even modulation level and constantly keep the signal peaks under check. The studio can maximize the level without fear of overloading.

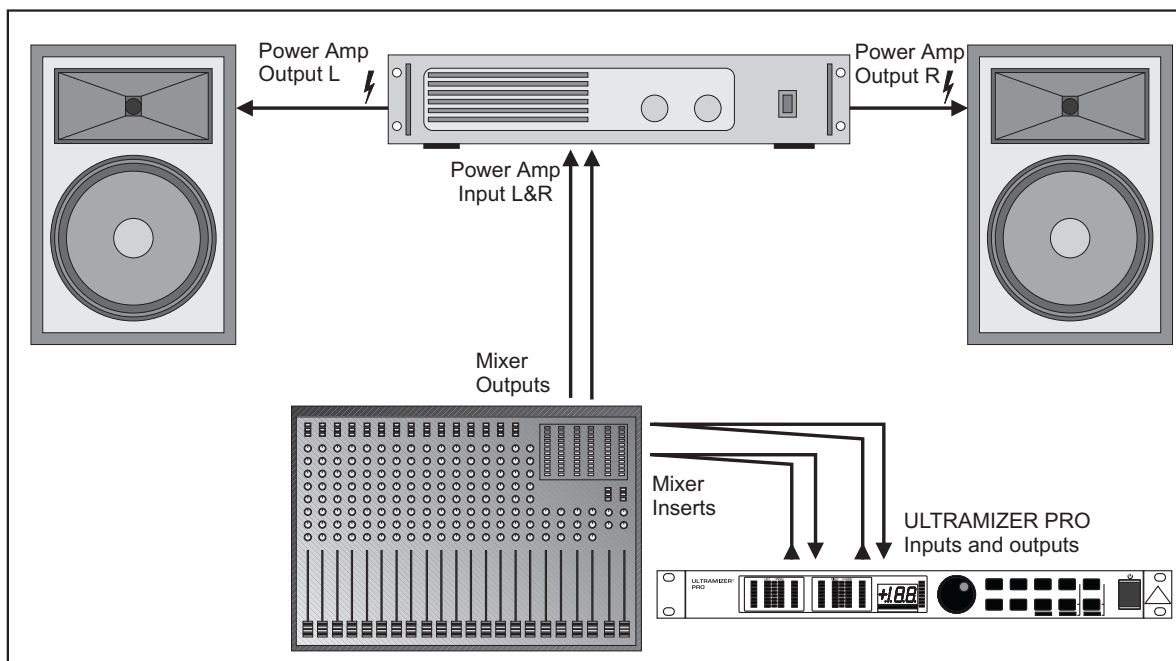## 3.6 Using the ULTRAMIZER PRO in inserts

Fig. 3.3: Inserting the ULTRAMIZER PRO in single channels and sub-groups

You can also insert the ULTRAMIZER PRO in single channels, sub-groups as well as the main mix channels. Use the first two options when you want to process individual signals or group of signals. This way you can process only the microphones or the DJ.

3.7 The ULTRAMIZER PRO in a MIDI setup

Owing to the integrated MIDI interface you can fully control the DSP1400P in a MIDI Setup. The ULTRAMIZER PRO can both receive and transmit Program CHANGES and CONTROLLER CHANGES. Wire the unit as follows.
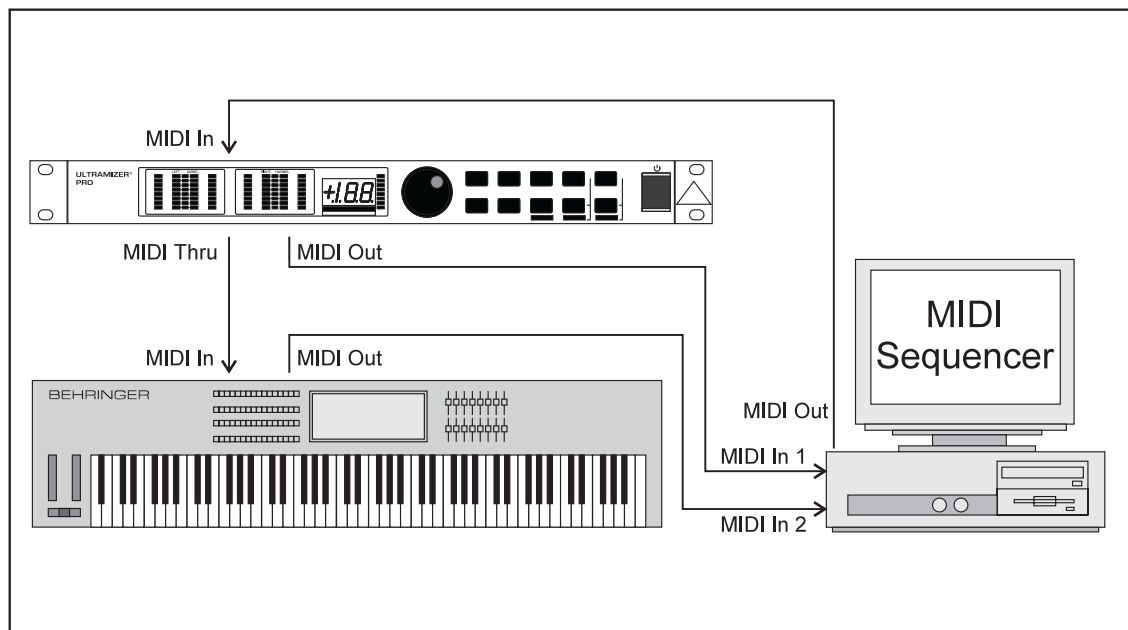

Fig. 3.4: The ULTRAMIZER PRO in a MIDI setup

3.8 Saving data via MIDI

The ULTRAMIZER PRO's MIDI implementation also allows for archiving one or several presets on an external storage medium. Proceed as follows:

Connect the MIDI OUT jack of the ULTRAMIZER PRO to the MIDI IN jack of a MIDI data recorder (e.g. sequencer). Press the PRESET and IN/OUT keys simultaneously to enter MIDI mode. Set program change mode to 0 and controller change mode to 3. Now quit MIDI mode by pressing the PRESET key. Use the jog wheel to select the preset whose data you wish to save. When the preset is activated its parameters are transmitted as controller data and can be recorded on a sequencer or similar device. Repeat this routine until all presets of your choice have been sent to the external data recorder.

To load archived data back into the ULTRAMIZER PRO, you must enable controller reception in MIDI mode (see 2.5). Then, start the sequencer to automatically transmit each preset data set back to the ULTRAMIZER PRO. Press the PRESET key, select a program location to store the data and then again press the PRESET key. If you want to automate MIDI store functions you must enable the store mode, to switch on the reception of controller #28. This allows you to directly store any modification of the actual preset on the preset number that is transmitted with the controller. You can also restore a complete preset that has previously been recorded with a MIDI sequencer on the same location it had before.

4. TECHNICAL BACKGROUND

The steady development of modern sound reinforcement systems has made it possible to produce almost any level of loudness. Yet, the increase in loudness goes in line with a need for optimized audio quality. Today, audiences expect to hear a powerful and transparent sound. To fully understand how the BEHRINGER ULTRAMIZER PRO works you will need to know the meaning of a decibel and how audio dynamics work.

With the ULTRAMIZER PRO, as with any other type dynamics processor the amount of boost/attenuation applied is expressed in decibels (dB). What's a decibel? The abbreviation dB is not a unit (although often used as one), but describes a logarithmic proportion. The entire dynamic range of human hearing (from the threshold of audibility to a jet-airplane, see fig. 4.1) starts with about 0.00002 Pa (threshold of audibility) and goes up to 130 Pa (threshold of pain). This also means that 0 dB is not silence, minus infinity dB will mean
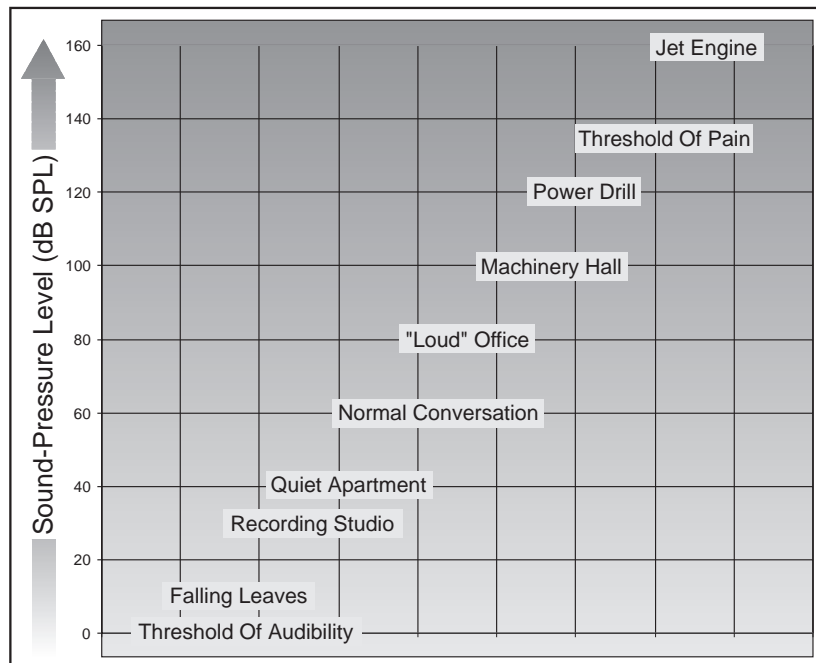
absolute silence.

Fig. 4.1: Dynamic range of human hearing

The range of sound pressure levels or the dynamic range of human hearing encompasses a factor of 10,000,000. This enormous range of values is difficult to handle and additionally does not represent the subjective perception of sound, since human hearing tends to use a logarithmic curve. When an increase in loudness by the factor two is perceived as one step, four times the loudness level equals two steps. So, the decibel is a unit of measurement that describes a level in relation to a reference quantity. To make clear which reference quantity is meant, the abbreviation SPL (sound pressure level) is sometimes used together with dB. Starting with a value of 0 dB SPL (= $2*10^{-5}$ Pa) for the threshold of audibility, any dB values can be calculated by means of the following formula:

$$L = 20 \cdot \log \frac{p_2}{p_1}$$

L = e.g. the absolute sound pressure level in dB SPL
p_1 = e.g. a reference sound pressure of 0.00002 Pa
p_2 = the sound pressure (in Pa) produced by the sound source to be calculated
log = decimal logarithm.

As can be seen, human hearing has a very wide dynamic range of about 130 dB, which surpasses the range of a DAT or CD player with an approximate range of 96 dB. From a physical point of view, a 3 dB boost corresponds to an increase in power by the factor 2. However, the human ear perceives a signal to be twice as loud as before only if it is boosted by about 10 dB.

4.1 Audio dynamics

As demonstrated it is possible to manufacture analog audio equipment with a dynamic range of up to 130 dB. In contrast to analog techniques, the dynamic range of digital equipment is approximately 25 dB less. With conventional record and tape recorder technology, as well as broadcasting, this value is further reduced. Generally, dynamic restrictions are due to noisy storage in transmission media and also the maximum headroom of these systems.

4.1.1 Noise as a physical phenomenon

All electrical components produce a certain level of inherent noise. Current flowing through a conductor leads to uncontrolled random electron movements. For statistical reasons, this produces frequencies within the whole audio spectrum. If these currents are highly amplified, the result will be perceived as noise. Since all frequencies are equally affected, we term this white noise. It is fairly obvious that electronics cannot function without components. Even if special low-noise components are used, a certain degree of basic noise cannot be avoided.

This effect is similar when replaying a tape. The non-directional magnetic particles passing the replay head can also cause uncontrolled currents and voltages. The resulting sound of the various frequencies is heard as noise. Even the best possible tape biasing can "only" provide signal-to-noise ratios of about 70 dB, which is not acceptable today since the demands of listeners have increased. Due to the laws of physics, improving the design of the magnetic carrier is impossible using conventional means.

4.1.2 What are audio dynamics?

The human ear can detect the most wide ranging amplitude changes - from the slightest whisper to the deafening roar of a jet-plane. If one tried to record or reproduce this wide spectrum of sound with the help of amplifiers, cassette recorders, records or even digital recorders (CD, DAT etc.), one would immediately be restricted by the physical limitations of electronic and acoustic sound reproduction technology.

The usable dynamic range of electroacoustic equipment is limited as much at the low end as at the high end. The thermal noise of the electrons in the components results in an audible basic noise floor and thus represents the bottom limit of the transmission range. The upper limit is determined by the levels of the internal operating voltages; if they are exceeded, audible signal distortion is the result. Although in theory, the usable dynamic range sits between these two limits, it is considerably smaller in practice, since a certain reserve must be maintained to avoid distortion of the audio signal if sudden level peaks occur. Technically speaking, we refer to this reserve as "headroom" - usually this is about 10 - 20 dB. A reduction of the operating level would allow for greater headroom, i.e. the risk of signal distortion due to level peaks would be reduced. However, at the same time, the basic noise floor of the program material would be increased considerably.
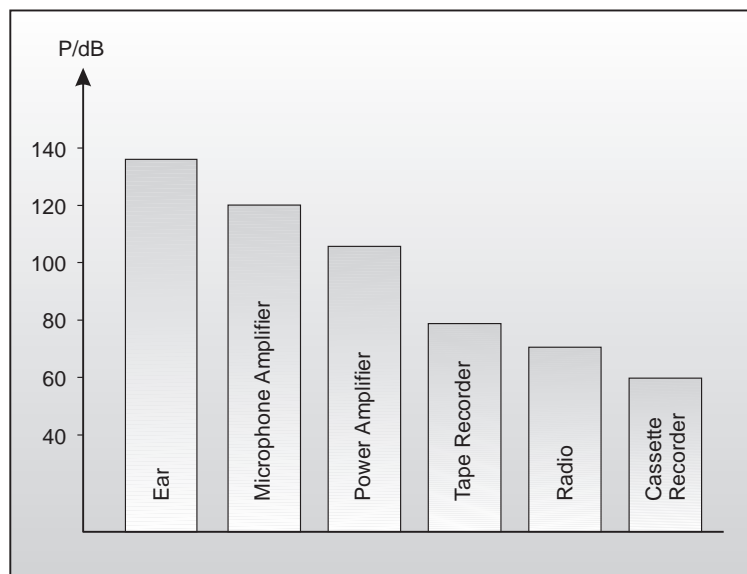
Fig. 4.2: The dynamic range capabilities of various devices

It is therefore useful to keep the operating level as high as possible without risking signal distortion in order to achieve optimum transmission quality.

It is possible to further improve the transmission quality by constantly monitoring the program material with the aid of a volume fader, which manually levels the material. During low passages the gain is increased, during loud passages the gain is reduced. Of course it is fairly obvious that this kind of manual control is rather restrictive; it is difficult to detect signal peaks and it is almost impossible to level them out. Manual control is simply not fast enough to be satisfactory.

Fig. 4.3: The interactive relationship between the operating level and the headroom

The need therefore arises for a fast acting automatic gain control system which will constantly monitor the signals and which will always adjust the gain to maximize the signal-to-noise ratio without incurring signal distortion. This device is called a compressor or limiter. This system is a part of the BEHRINGER ULTRAMIZER PRO.
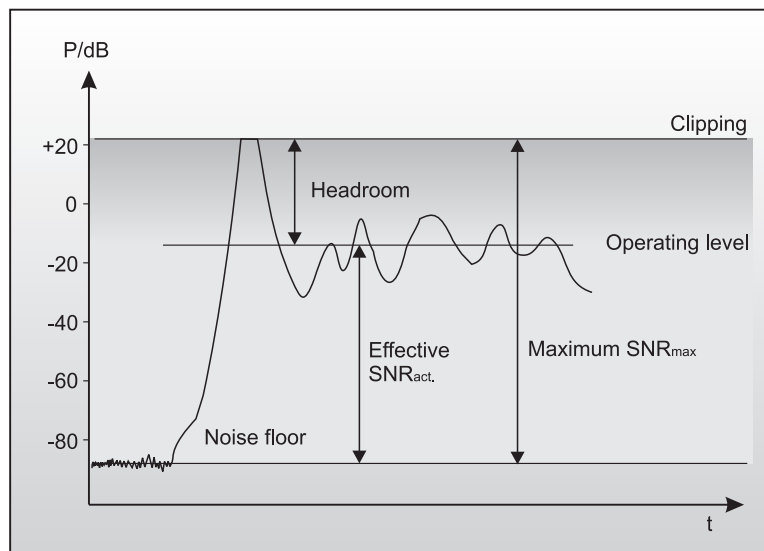
4.1.3 Compressors/Limiters

With broadcasting and recording, signal peaks can easily lead to distortion due to the high dynamic range of microphones and other musical equipment. Compressors and limiters reduce the dynamics by means of an automatic gain control. This reduces the amplitude of loud passages and therefore, restricts the dynamics to a desired range. This application is particularly useful with microphones, to compensate for level changes.

Although compressors and limiters perform similar tasks, one essential point makes them different: limiters abruptly limit the signal above a certain level, while compressors control the signal "gently" over a wider range. Both continuously monitor the signal and intervene as soon as the level exceeds a user-adjustable threshold. Any signal exceeding this threshold will be immediately reduced in level.

Limiters reduce the output level to the adjusted threshold whenever the input signal exceeds this point. With compression, in contrast to the action of a limiter, the signal is reduced in gain relative to the amount the signal exceeds the threshold. The output of a compressor will still rise if the input level is increased, while the maximum output of a limiter will always be equal to the threshold level.

Generally, threshold levels for compressors are set below the normal operating level to allow for the upper dynamics to be musically compressed. For limiters, the threshold point is set above the normal operating level so that it only intervenes to protect subsequent equipment from signal overload.

The speed, or rather time settings used can differ greatly depending on use. Although both limiter and compressor use very short attack times, the release time of a compressor are in the 100 ms region whereas a limiter uses release times of seconds. To be exact: The release time is a time constant of an exponential function. It is the time it takes the gain reduction to decrease by 63.2 % (= 8.7 dB).

Because fast level changes are more noticeable than slow changes, long release times are used where unobtrusive signal processing is required. In some cases however, the principal goal is to protect devices as loudspeakers and power amplifiers. In those cases a short release time is more appropriate to ensure that the limiter only intervenes when it is needed and the level returns to normal as soon as possible.

Long release times are better suited when the limiter should remain "inaudible" for instance with broadcasting or club applications or when a signal is transferred to (analog) tape. Please note that when using slow release times you should switch to the level meter menu where the functioning of the limiter can be monitored.

4.1.4 Expanders/Noise Gates

Audio, in general, is only as good as the source from which it is derived. The dynamic range of signals will often be restricted by noise. Synthesizers, effects devices, guitar pickups, amplifiers etc. generally produce a high level of noise, hum or other ambient background hiss, which can disturb the quality of the program material.

Normally these noises are inaudible if the level of the desired signal lies significantly above the level of the noise. This perception by the ear is based on the "masking" effect: noise will be masked and thus becomes inaudible as soon as considerably louder sound signals in the same frequency band are added. Nevertheless, the further the level that the desired signal decreases, the more the noise floor becomes a disturbing factor. Expanders or noise gates offer a solution for this problem: these devices attenuate signals when their amplitudes drop, thereby fading out the background noise. Relying on this method, gain controlling amplifiers, like expanders, can extend the dynamic range of a signal and are therefore the opposite of a compressor.

In practice, it is shown that an expansion over the entire dynamic range is not desired. With an expansion ratio of 5:1 and a processed dynamic range of 30 dB, an output dynamic range of 150 dB will be the result, exceeding all subsequent signal processors, as well as human hearing. Therefore, the amplitude control is restricted to signals whose levels are below a certain threshold. Signals above this threshold pass through the unit unchanged. Due to the continuous attenuation of the signals below this threshold, this kind of expansion is termed "downward" expansion.

The noise gate is the simplest form of an expander: in contrast to the expander, which continuously attenuates a signal below the threshold, the noise-gate cuts off the signal abruptly. In most applications this method is not very useful, since the on/off transition is too drastic. The onset of a simple gate function appears very obvious and unnatural.

4.2 Denoiser

The noise reduction system of the ULTRAMIZER PRO is based on two signal processing techniques. As already described a downward expander automatically reduces the overall level for all signals below an adjustable threshold and therefore reduces the noise in pauses. The second function of the BEHRINGER Denoiser is based on the "masking" effect: noise will be masked and thus become inaudible, as soon as considerably louder sound signals are added.

In the Denoiser function a dynamically controlled low-pass filter is implemented which allows low frequencies to pass but filters the highs, depending on the music material. In contrast to conventional noise filters with fixed cut-off frequencies, the BEHRINGER Denoiser shifts the cut-off frequency between 800 Hz and 20 kHz, the exact frequency depending on the program material. This is the range where noise is considered most annoying. The cut-off frequency of the filter depends both on the input level and the frequency spectrum of the audio signal.

In simple terms, what this means is that if a signal appears at the input which has primarily bass components, the dynamic filter will reduce any mid or high-band noise, eliminating any possible breathing side effects. If the input signal has high frequency components present, the dynamic filter will open to its full extent to pass the signal and eliminate the possibility of any loss of high frequency response.

4.3 Artificial harmonics generation – Exciter

By 1955 an American, Charles D. Lindridge, had already invented the first "EXCITER" (a unit that EXCITES upper harmonics), when he presented a unit for "improving the sound of music and speech". He enriched signal sources with artificially generated upper harmonics and found that both sound quality, transparency and perceived positioning of musical instruments could be considerably improved using this effect. He was granted an American patent on his circuit design under the number US 2 866 849.

Compared to modern technology, Lindridge's circuit was anything but fully developed, however, it featured many of the aspects found in today's modern circuit designs.

Psycho-acoustic discoveries and greater knowledge, gathered over the years, have allowed for new and improved circuit designs, through the use of advanced technology.

4.4 Super Bass

Apart from processing the upper harmonic ranges, users of the BEHRINGER ULTRAMIZER PRO have access to an innovative Bass Processor.

The numerous stages of processing during the recording, reproduction, copying and effecting processes, increasingly delay the phase of the bass frequencies, when compared to the remaining frequency ranges. This is why the low-frequency range suffers from a loss in power and fundamental bass definition.

With the help of frequency-selective phase shift combined with sub-bass boost, the bass processor of the BEHRINGER ULTRAMIZER PRO is capable of compensating for this loss, giving the program material new bass presence.

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4.5 3D Surround Processor

Sound quality during signal transmission is given top priority today. The signal is processed with the help of Reverb Devices, Compressors, Exciters, Denoisers etc. to produce a compact, low-noise and transparent sound.

However, the fact that hearing impression depends largely upon the positioning of the instruments within the stereo panorama is often enough neglected. Using the 3D Surround processor of the ULTRAMIZER PRO, the intensity of the stereo effect can be dramatically improved. The program material gains in liveliness, loudness and transparency. As in a cinema with its special acoustics, the listener has the impression that the orchestral instruments are placed all around him. The 3D Surround processor enlarges the stereo basis dependent on the program material, without audibly coloring the sonic image.

The function of the 3D Surround Processor is based on the derivation of a special signal, which is generated from the difference of the left an right channel. This signal is then delayed program dependently and mixed with the original signal. The difference between the two channels is the "stereo substance" whose ambient and spatial information is improved by delaying the signal.

☞ **Due to the described function, the 3D Surround Processor is principally useful only with stereo program material.**

4.6 Digital audio processing

In order to convert an analog signal - e.g. music - into a series of digital words, a so-called "Analog to Digital Converter" or ADC is used. The converter functions by viewing the signal entering it a given number of times over a period of time, e.g. 44,100 times per second, giving a rate of 44.1 kHz, and in each case measuring the signal amplitude, and giving it a numerical value. This form of measuring the signal regularly over a period of time is known as "sampling", the conversion of the amplitude into a numerical value, quantizing. The two actions together are referred to as digitizing.

In order to carry out the opposite - the conversion of a digitized signal into its original analog form - a "Digital to Analog Converter" or DAC is used. In both cases the frequency at which the device operates is called the sampling rate. The sampling rate determines the effective audio frequency range. The sampling rate must always be more than twice the value of the highest frequency to be reproduced. Therefore, the well known CD sampling rate of 44.1 kHz is slightly higher than twice the highest audible frequency of 20 kHz. The accuracy at which quantization takes place is primarily dependent on the quality of the ADCs and DACs being used.

The resolution, or size of digital word used (expressed in bits), determines the theoretical signal/noise ratio (S/N ratio) the audio system is capable of providing. The number of bits may be compared to the number of decimal places used in a calculation - the greater the number of places, the more accurate the end result. Theoretically, each extra bit of resolution should result in the S/N ratio increasing by 6 dB. Unfortunately, there are a considerable number of other factors to be taken into account, which hinder the achievement of these theoretical values.
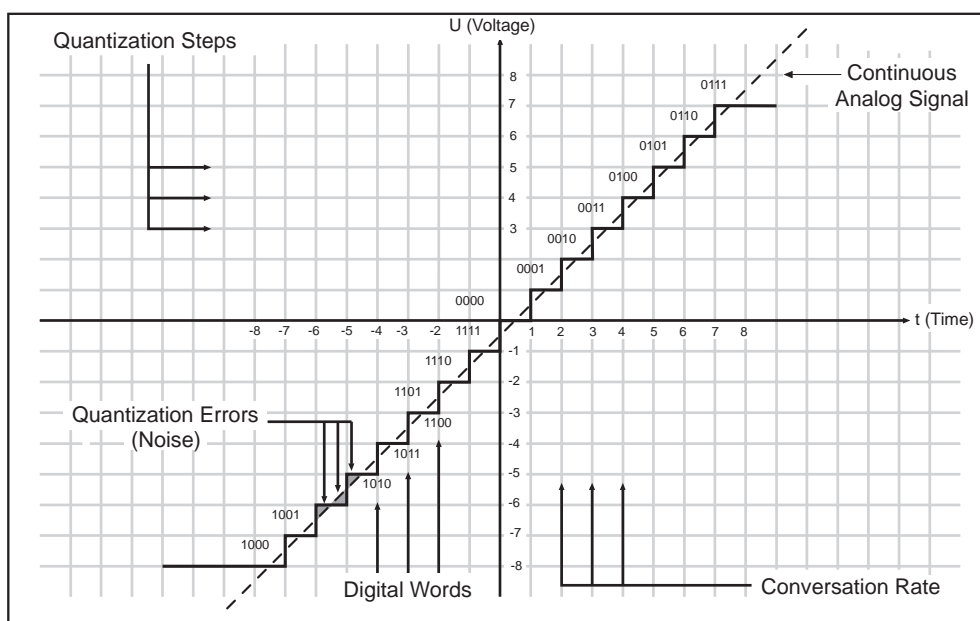
Fig. 4.4: Transfer diagram for an ideal linear ADC (2's complement representation)

If you picture an analog signal as a sinusoidal curve, then the sampling procedure may be thought of as a grid superimposed on the curve. The higher the sampling rate (and the higher the number of bits), the finer the grid. The analog signal traces a continuous curve, which very seldom coincides with the cross points of the grid. A signal level at the sampling points will still be assigned a digital value, usually the one closest to the exact representation. This limit to the resolution of the grid gives rise to errors, and these errors are the cause of quantizing noise. Unfortunately, quantizing noise has the characteristic of being much more noticeable and unpleasant to the ear than "natural" analog noise.

In a digital signal processor, such as the DSP in the ULTRAMIZER PRO, the data will be modified in a number of ways, in other words, various calculations, or processes, will be done in order to achieve the desired effect on the signal. This gives rise to further errors, as these calculations are approximations, due to their being rounded off to a defined number of decimal places. This causes further noise. To minimize these rounding off errors, the calculations must be carried out with a higher resolution than that of the digital audio data being processed (as a comparison, an electronic calculator may operate internally with a greater number of decimal places than can be shown on its display). The DSP in the ULTRAMIZER PRO operates with a 24 bit resolution. This is accurate enough to reduce quantizing noise to levels which are usually below the audible threshold.

5. INSTALLATION

Your BEHRINGER ULTRAMIZER PRO was carefully packed in the factory and the packaging was designed to protect the unit from rough handling. Nevertheless, we recommend that you carefully examine the packaging and its contents for any signs of physical damage, which may have occurred in transit.

☞ **If the unit is damaged, please do not return it to us, but notify your dealer and the shipping company immediately, otherwise claims for damage or replacement may not be granted. Shipping claims must be made by the consignee.**

5.1 Rack mounting

The BEHRINGER ULTRAMIZER PRO fits into one standard 19" rack unit of space (1 3/4"). Please allow at least an additional 4" depth for the connectors on the back panel. Be sure that there is enough air space around the unit for cooling and please do not place the ULTRAMIZER PRO on high temperature devices such as power amplifiers etc. to avoid overheating.

5.2 Mains connection

The mains connection of the ULTRAMIZER PRO is made by using a mains cable and a standard IEC receptacle. It meets all of the international safety certification requirements.

☞ **Please make sure that all units have a proper ground connection. For your own safety, it is advisable not to remove the ground connection within the units or at the supply, or fail to make this connection at all.**

Before you switch on the unit, check that it is configured to match your AC mains voltage requirements. If it does not comply, then it is necessary to switch the operating voltage to the correct supply requirements BEFORE turning on the unit, otherwise the unit could be severely damaged. You will find this combined fuse holder/voltage selector at the back, adjacent to the IEC receptacle. **IMPORTANT: This does not apply for general export models which are built for one operating voltage only.**

The AC voltage selection is defined by the position of the fuse holder. If you intend to change the operating voltage, remove the fuse holder and twist it by 180 degrees before you reinsert it. Matching the two markers monitors the selected voltage.

☞ **If the unit is switched to an other operating voltage, the ruse rating must be changed. See the technical specifications in the appendix.**

A safety fuse protects the unit from serious defects. If the fuse blows, this is a warning sign and always indicates that the circuit is overloaded. The fault must always be repaired before the fuse is replaced. If the safety fuse is faulty and needs replacing after the unit is repaired, please make sure that you replace it only with the identical type and rating. NEVER use fuses of different ratings or cover faulty fuses with aluminium foil. This can cause fire and electric shocks and will endanger your life and the lives of others.

5.3 Audio connections

As standard, the BEHRINGER ULTRAMIZER PRO is installed with electronically servo-balanced inputs and outputs. The new circuit design features automatic hum and noise reduction for balanced signals and thus allows for trouble-free operation, even at high operating levels. Externally induced mains hum etc. will be effectively suppressed. The automatic servo-function recognizes the presence of unbalanced connectors and adjusts the nominal level internally to avoid level differences between the input and output signals (correction 6 dB).

☞ **Please ensure that only qualified persons install and operate the ULTRAMIZER PRO. During installation and operation the user must have sufficient electrical contact to earth. Electrostatic charges might affect the operation of the ULTRAMIZER PRO!**
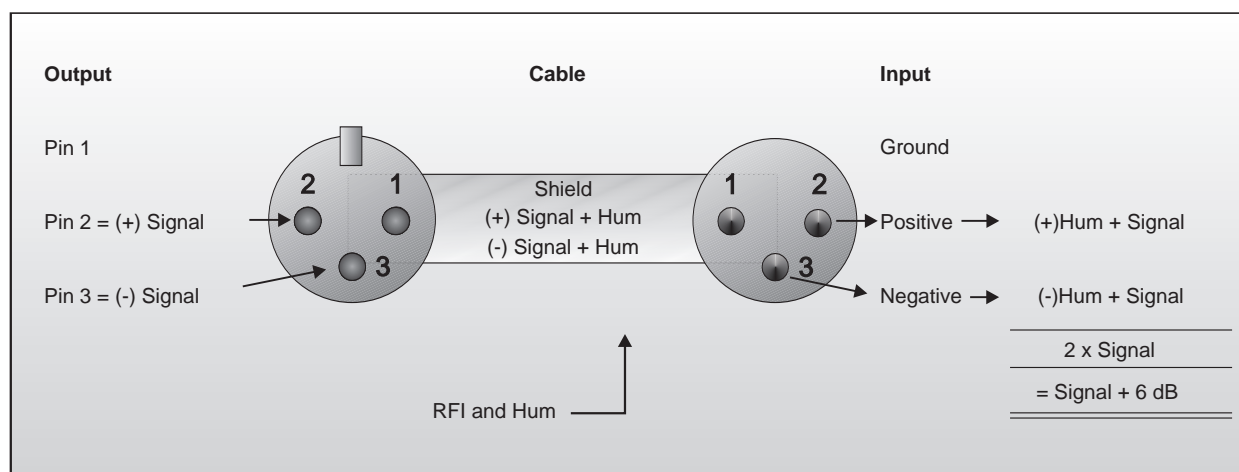

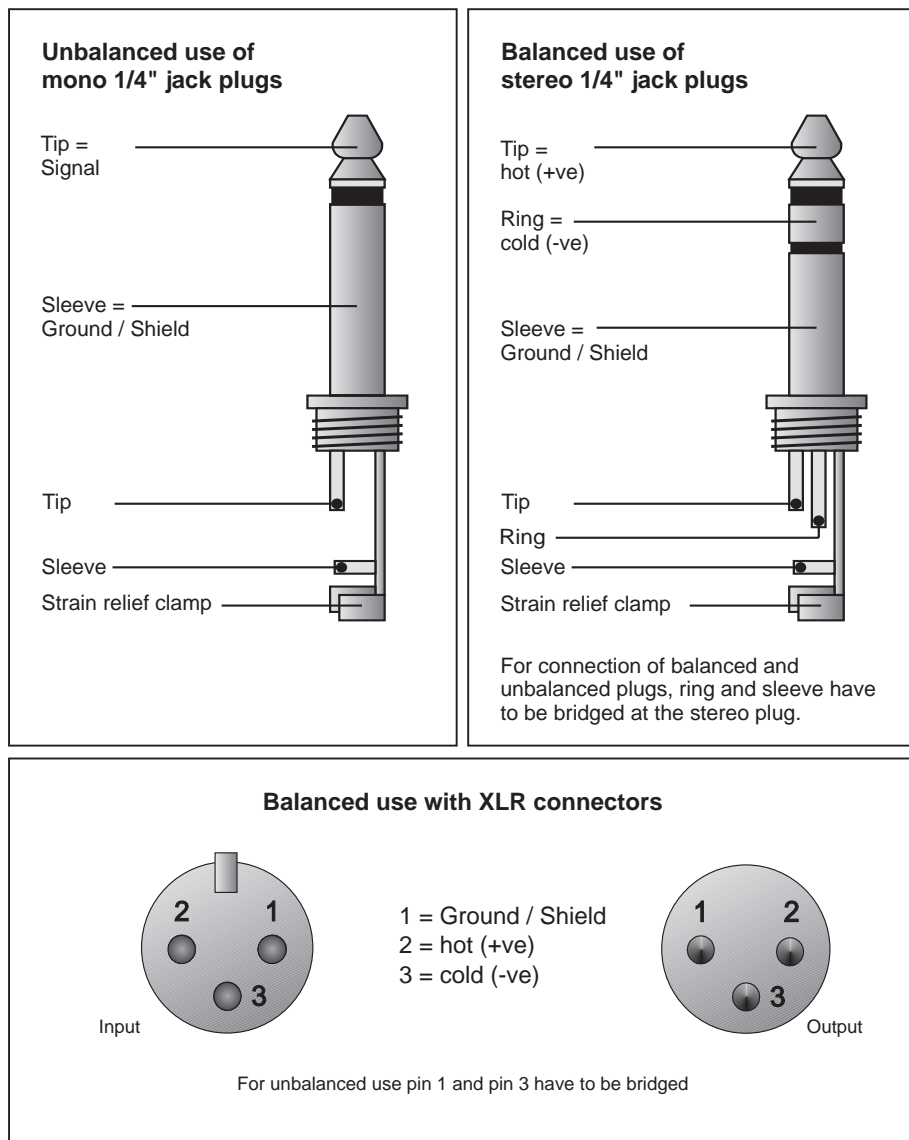*Fig. 5.1: Compensation of interference with balanced connections*

Unbalanced use of mono 1/4" jack plugs

Tip = Signal

Sleeve = Ground / Shield

Tip

Sleeve

Strain relief clamp

Balanced use of stereo 1/4" jack plugs

Tip = hot (+ve)

Ring = cold (-ve)

Sleeve = Ground / Shield

Tip

Ring

Sleeve

Strain relief clamp

For connection of balanced and unbalanced plugs, ring and sleeve have to be bridged at the stereo plug.

Balanced use with XLR connectors

1 = Ground / Shield
2 = hot (+ve)
3 = cold (-ve)

Input

Output

For unbalanced use pin 1 and pin 3 have to be bridged

Fig. 5.2: Different plug types

5.4 MIDI connections

The MIDI standard was developed in the early 1980s to allow electronic musical instruments from different manufacturers to communicate with each other. The use of MIDI has developed over the intervening years to the stage where it is now common to find complete recording studios operating entirely on a MIDI basis. The centerpiece in such a studio is usually a computer running a sequencer software which not only controls various keyboards, samplers and sound modules, but can also run the programming of outboard effect devices, typically digital reverberation and delay units. The ULTRAMIZER PRO may be controlled in real time in this studio environment.

☞ **MIDI for Musical Instruments Digital Interface.**

The MIDI connectors found on the rear panel are of the universally used 5 pin DIN type. You require suitable MIDI cables to connect the ULTRAMIZER PRO to other MIDI devices. Normally complete cables will be purchased for this use, you can of course make your own, using a high quality cable with two cores and shielding (like microphone cable), with as connectors two good 180 degree DIN plugs. Pin 2 (center) is connected to the cable's shield, pins 4 and 5 (left and right next to 2) carry the two cores, pins 1 and 3 are not used. MIDI cables should have a maximum length not exceeding 45 feet.

MIDI IN: to receive MIDI-data. The receive MIDI channel is set in the MIDI SETUP menu.

MIDI THRU: The unaltered signal is spresent at the MIDI THRU connector. Several ULTRAMIZER PROs can

be linked using this connector.

MIDI OUT: Use the MIDI OUT to transfer data to a computer or an other ULTRAMIZER PRO. Program changes and status information is sent.

5.5 Operating level switch

To adapt the ULTRAMIZER PRO to the appropriate operating level, the unit can be switched between home-recording level (-10 dBV) and professional level (+4 dBu). Use the LED bars on the frontpanel to determine the optimal setting. The level indicators should read somewhere around -10 dB, while the CLIP LED should not light up at all.

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6. APPENDIX

6.1 MIDI implementation

MIDI Implementation chart			
Function		**Transmitted**	**Recognized**	**Remarks**
Basic	Default	OFF, 1 - 16	OFF, 1 - 16	memorized
Channel	Changed	OFF, 1 - 16	OFF, 1 - 16	
Mode	Default	1,2,3,4	1,2,3,4	
	Messages	X	X	
	Altered	X	X	
Note Number		X	X	
	True Voice	X	X	
Velocity	Note ON	X	X	
	Note OFF	X	X	
After Touch	Key´s	X	X	
	Ch´s	X	X	
Pitch Bender		X	X	
Control		O 70 - 87	O 70 - 87	see add. Table
Progr.		O (0-49)	O (0-49)	
Change	True #	1-50	1-50	
System Exclusive		X	X	
System	Song Pos	X	X	
Common	Song Sel	X	X	
	Tune	X	X	
System	Clock	X	X	
Real Time	Commands	X	X	
Aux	Local ON/OFF	X	X	
	All notes OFF	X	X	
Messages	Active Sense	X	X	
	Reset	X	X	
Notes				

O = YES, X = NO
Mode 1:   OMNI ON, POLY
Mode 2:   OMNI ON, MONO
Mode 3:   OMNI OFF, POLY
Mode 4:   OMNI OFF, MONO

Tab. 6.1: MIDI implementation chart

Parameter Name	Display Range	Midi Control Number	Control Value Range
Max. Out Level	-48 .. 0	70	0 .. 48
RMS Mode		71	0 = Peak, 1 = RMS
Stereo Width	0 .. 100	72	0 .. 100
Ultramizer Density	0 .. 100	73	0 .. 100
Ultramizer Speed	1 .. 100	74	0 .. 99
Ultramizer Range	0 .. 24	75	0 .. 24
Denoiser Threshold	OF, -90 .. 0	76	0 .. 91
Denoiser Sensitivity	0..100	77	0 .. 100
Left / Right	-	78	0 = coupled, 1 = L, 2 = R
Exciter Process	0 .. 100	79	0 .. 100
Exciter Tune	4 .. 12	80	0 .. 100
Super Bass Process	0 .. 100	81	0 .. 100
Super Bass Tune	50 .. 150	82	0 .. 100
Crossover	20 (Hz) .. 20 (kHz)	83	0 .. 30
Low Mute	-	84	0 = On, 1 = Mute
High Mute	-	85	0 = On, 1 = Mute
Store	-	86	0 .. 49
In / Out	-	87	0 = Out, 1 = In

Tab. 6.2: Controller functions with MIDI

6.2 Specifications

Analog Inputs

Connectors	XLR and 1/4" jack
Type	RF filtered, servo balanced input
Impedance	50 kOhms balanced, 25 kOhms unbalanced
Nominal Operating Level	-10dBV to +4dBu
Max. Input Level	+16 dBu at +4 dB nominal level, +2 dBV at -10 dBV nominal level

Analog Outputs

Connectors	XLR and 1/4" jack
Type	Electronically servo-balanced output stage
Impedance	60 Ohms balanced, 30 Ohms unbalanced
Max. Output Level	+16 dBu at +4 dB nominal level, +2 dBV at -10 dBV nominal level

System specifications

Bandwidth	20 Hz to 20 kHz, +0/-0.5 dB
Frequency Response	0.35 Hz to 200 kHz, +0/-3 dB
Noise	>-95 dBu, unweighted, 22 Hz to 22 kHz
THD	0.008 % typ. @ +4 dBu, 1 kHz, Gain 1
	0.04 % typ. @ +16 dBu, 1 kHz, Gain 1
IMD	0.01 % typ. SMPTE
Crosstalk	<-100 dB, 22 Hz to 22 kHz

MIDI Interface

Type	5-Pin-DIN-Socket IN / OUT / THRU
Implementation	Refer to MIDI Implementation Chart in Chapter 8

Digital Processing

Converters	20-bit Sigma-Delta, 64/128-times Oversampling
Sampling Rate	46 kHz

Display

Type	2 ½-digit numeric LED-Display

Power Supply

Mains Voltages	
USA/Canada	~ 115 V AC, 60 Hz
U.K./Australia	~ 240 V AC, 50 Hz
Europe	~ 230 V AC, 50 Hz
General Export Model	~ 100-120 V AC, ~ 200-240 V AC, 50-60 Hz
Fuse	100-120 V AC: **250 mA (slow-blow)**
	200-240 V AC: **125 mA (slow-blow)**
Power Consumption	10 Watts
Mains Connection	Standard IEC receptacle

Physical

Dimensions (H * W * D)	1 3/4" (44.5 mm) * 19" (482.6 mm) * 7 1/2" (190.5 mm)
Net Weight	2 kg
Shipping Weight	3.2 kg

7. WARRANTY

§ 1 WARRANTY CARD

To be protected by this warranty, the buyer must complete and return the enclosed warranty card (signed/stamped by retail dealer) within 14 days of the date of purchase to BEHRINGER INTERNATIONAL (address see § 3). Failure to return the card in due time (date as per postmark) will void any extended warranty claims.

§ 2 WARRANTY

1. BEHRINGER INTERNATIONAL warrants the mechanical and electronic components of this product to be free of defects in material and workmanship for a period of one (1) year from the original date of purchase, in accordance with the warranty regulations described below. If any defects occur within the specified warranty period that are not caused by normal wear or inappropriate use, BEHRINGER INTERNATIONAL shall, at its sole discretion, either repair or replace the product.

2. If the warranty claim proves to be justified, the product will be returned freight prepaid by BEHRINGER INTERNATIONAL within Germany. Outside of Germany, the product will be returned at the buyer's expense.

3. Warranty claims other than those indicated above are expressly excluded.

§ 3 RETURN AUTHORIZATION NUMBER

1. To obtain warranty service, the buyer must call BEHRINGER INTERNATIONAL during normal business hours BEFORE returning the product (Tel.: +49 (0) 21 54 / 92 06 66). All inquiries must be accompanied by a description of the problem. BEHRINGER INTERNATIONAL will then issue a return authorization number.

2. The product must be returned in its original shipping carton, together with the return authorization number, to the following address:

BEHRINGER INTERNATIONAL GmbH
Service Department

Hanns-Martin-Schleyer-Str. 36-38

D - 47877 Willich-Münchheide

3. Shipments without freight prepaid will not be accepted.

§ 4 WARRANTY REGULATIONS

1. Warranty services will be furnished only if the product is accompanied by an original retail dealer's invoice. Any product deemed eligible for repair or replacement by BEHRINGER INTERNATIONAL under the terms of this warranty will be repaired or replaced within 30 days of receipt of the product at BEHRINGER INTERNATIONAL.

2. If the product needs to be modified or adapted in order to comply with applicable technical or safety standards on a national or local level, in any country which is not the country for which the product was originally developed and manufactured, this modification/adaptation shall not be considered a defect in materials or workmanship. The warranty does not cover any such modification/adaptation, irrespective of whether it was carried out properly or not. Under the terms of this warranty, BEHRINGER INTERNATIONAL shall not be held responsible for any cost resulting from such a modification/adaptation.

3. Free inspections, maintenance/repair work and replacement of parts are expressly excluded from this warranty, in particular if caused by inappropriate use. Likewise, the warranty does not cover defects of expendable parts caused by normal wear of the product. Expendable parts are typically faders, potentiometers, switches and similar components.

4. Damages/defects caused by the following conditions are not covered by this warranty:

▲ misuse, neglect or failure to operate the unit in compliance with the instructions given in the user or service manuals.

▲ connection or operation of the unit in any way that does not comply with the technical or safety regulations applicable in the country where the product is used.

▲ damages/defects that are caused by force majeure or by any other condition beyond the control of BEHRINGER INTERNATIONAL.

5. Any repair carried out by unauthorized personnel will void the warranty.

6. Products which do not meet the terms of this warranty will be repaired exclusively at the buyer's expense. BEHRINGER INTERNATIONAL will inform the buyer of any such circumstance. If the buyer fails to submit a written repair order within 4 weeks after notification, BEHRINGER INTERNATIONAL will return the unit C.O.D. with a separate invoice for freight and packing. Such cost will also be invoiced separately when the buyer has sent in a written repair order.

§ 5 WARRANTY TRANSFERABILITY

This warranty is extended exclusively to the original buyer (customer of retail dealer) and is not transferable to anyone who may subsequently purchase this product. No other person (retail dealer, etc.) shall be entitled to give any warranty promise on behalf of BEHRINGER INTERNATIONAL.

§ 6 CLAIM FOR DAMAGES

Failure of BEHRINGER INTERNATIONAL to provide proper warranty service shall not entitle the buyer to claim (consequential) damages. In no event shall the liability of BEHRINGER INTERNATIONAL exceed the invoiced value of the product.

§ 7 OTHER WARRANTY RIGHTS

This warranty does not exclude or limit the buyer's statutory rights provided by national law, in particular, any such rights against the seller that arise from a legally effective purchase contract.